This document is a translation of the original document, written in Spanish for Comisión Estatal de Servicios Públicos de Tijuana (CESPT), the water and wastewater operating agency for the municipalities of Tijuana and Playas de Rosarito, Baja California, Mexico.

CDM

Contents

Appendices Only

APPENDIX R
Methodology Used to Estimate Costs

Appendix R
Methodology Used to Estimate Costs

Equations for Capital Costs and Operating and Maintenance Costs

Following are the equations that estimate capital and operating and maintenance costs for the different types of infrastructure. The equations have been adjusted for consistency when using flows in l/s and dollars.

1.0 Wastewater Treatment Plants (WWTPs)

1.1 Capital Cost

Capital Cost (US $) = (10,456,146+188,050*Q)/10

Q is equal to average flow

Source: CNA (National Water Commission)

1.2 Operation and Maintenance

O&M (US $ /year) = (Capital Cost *0.02)+(10,210*$Q^{0.3669}$+10,208*Q+2,980,305)/10

Q is equal to average flow

Source: Calculated energy and labor requirements multiplied by CESPT's real cost of labor and kW-hr. 2 percent of the capital cost for repairs was added.

2.0 Conventional Water Treatment

2.1 Capital Cost

Capital Cost (US $) = 2,029,367*$(Q/43.81)^{0.86}$

Q is equal to maximum daily flow in l/s (divided by 43.81 because original equation is in mgd)

Source: Cost curve created by CDM.

2.2 Operation and Maintenance

O&M (US $/year) = 24,856.5*(Q/43.81)+680,000

Q is equal to average flow in l/s

Source: Cost curve created by CDM.

3.0 Desalination

3.1 Capital Cost

Capital Cost (US $) = 4,824,167*(Q/43.81)$^{0.95}$

Q is equal to design flow in l/s

Source: Curve created by CDM based on information available in the U.S.

3.2 Operation and Maintenance

O&M (US $/year) = 2,075,081*(Q/43.81)$^{0.722}$

Q is equal to average flow in l/s

Source: Curve created by CDM

4.0 Microfiltration/Reverse Osmosis

4.1 Capital Cost

Capital Cost (US $) = 4,034,417*(Q/43.81)$^{0.9242}$

Flow (Q) is calculated based on the flow needed to extract from the reservoirs or aquifers, after the treated water is discharged. It is assumed that the membrane filters have 70 percent efficiency, and the rate between recovery and quantity of effluent is 56 percent for the reservoir and 50 percent for the aquifer.

Source: Curve created by CDM based on information available in the U.S.

4.2 Operation and Maintenance

O&M (US $/year) = 240,028*(Q/43.81)$^{1.067}$

Q is equal to average flow in l/s

Source: Curve created by CDM

5.0 Río Colorado Aqueduct

5.1 Capital Cost

Capital Cost (US $) = 288,786,667*Q

Q equals average flow in l/s

Source: Binational Aqueduct Study. Each alternative is assigned a cost based on the flow of the aqueduct projected until the year 2023, proportionate to the cost and total flow furnished by the study.

5.2 Operation and Maintenance

O&M (US $ / year) = 3.23*(Annual volume)/10

Annual volume is expressed in m^3/year

Source: Real operation costs by cubic meter (Mx$3.23/$m^3$) furnished by CESPT

6.0 Pumping

6.1 Capital Cost

Capital Cost (US $) = 9,303.47*$P^{0.8491}$

P equals Horsepower. The horsepower requirements are calculated using the maximum daily flow for water and maximum projected flow for wastewater.

Source: Curve created by CDM

6.2 Operation and Maintenance

O&M (US $/year) = (11,835*$P^{0.9628}$)/10

P equals horsepower. The equation is based on the calculation of kW hours necessary to operate the pumping station for average flow and on the average cost for kW hours established by CESPT (Mx$1.17/kW-hr).

7.0 Water and sewage pipes

7.1 Capital Cost

For pipes with diameters greater than 20 inches:

Capital Cost (US $) = (Length*(0.0446*$D^2$ + 51.102*D – 523.69))/10

Where D equals diameter in centimeters and length is written in meters

Source: Equations created by SI+I for different diameters using CNA unit prices

For pipes with diameters less than or equal to 20 inches:

Capital Cost (US $) = (Length*(0.5446*$D^2$ + 4.728*D + 258.3))/10

Where D equals diameter in centimeters and the length is written in meters

Source: Equations created by SI+I for different diameters using CNA unit prices

7.2 Operation and Maintenance

Two percent of the capital cost is used.